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EVALUATION OF NON-NATIVE EUCALYPTUS GROVES IN THE GOLDEN GATE NATIONAL RECREATION AREA

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ABSTRACT

Three areas containing stands of undesirable eucalyptus were evaluated for pest problems. Eucalyptus is considered undesirable because it is non-native and hazardous from both fire and tree failure perspectives. Pest impacts were minimal except for situations involving potentially hazardous trees. Meeting vegetation management objectives through eucalyptus removal is complicated because the elimination of this species will affect residual vegetation on Park Service land and bordering private property. Alternatives in addition to complete removal of eucalyptus are discussed.

INTRODUCTION

The Forest Pest Management Group of the State and Private Forestry Staff, USDA Forest Service, was requested to evaluate a proposal to remove eucalyptus trees at three locations in the Golden Gate National Recreation Area (GGNRA). John Pronos, Pathologist, and Dave Schultz, Entomologist, accompanied by Tom Gavin, Terri Thomas and Nancy Hornor from the National Park Service examined the areas on March 27, 1986.

Three primary objectives established for forested sites in GGNRA are to 1) return the area to native vegetation, 2) reduce hazard of injury or property loss due to tree failure, and 3) reduce fire hazard. The presence of eucalyptus is currently interfering with each of these objectives, to one degree or another, at all three locations visited.

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SMITH ROAD AREA

Observations

The National Park Service manages a multi-acre parcel which abuts a residential area along Smith Road, southwest of San Rafael, California. A right-of-way of varying width owned by Marin County separates the GGNRA parcel from Smith Road and some of the adjacent land owners. The vegetation in the GGNRA parcel and the right-of-way is similar. There is an exceptionally tall and dense overstory of eucalyptus. Tree heights reach 240 feet and basal areas are commonly over 250 sq.ft./acre. Competition throughout the life of the stand has led to single-stemmed trees with clear, straight boles and very small crowns and root systems. The ground was covered by a considerable accumulation of eucalyptus leaves, bark and branches. The relative scarcity of vegetative ground cover and understory may be due to the physical depth of the litter, allelopathic (toxic) chemicals leaching from eucalyptus foliage, dense shade created by the overstory, or any combination of these factors.

There have been some branch failures in the past. Although some of these branches were 10 or more feet in length, they rarely were more than a few inches in diameter due to the small size of the crowns. There was also evidence of past tree uprooting. Entire root masses with associated soil have been lifted out, probably by a combination of very tall trees with small root systems growing in soil which becomes saturated during the winter. No evidence of root disease was found. Leaning trees were noticeable along the edges of openings created by trespass cutting.

Top and branch dieback of eucalyptus were common in the area . No insects or disease organisms were associated with the dieback. Past hard freezes and/or drought may have been involved, but the most significant factor contributing to the dieback is that the stand appears to have exceeded the long-term carrying capacity of the site.

Discussion

The situation at Smith Road is complex because the objectives of the Park Service, and what is required to meet them, affects the neighboring private property. The following discussion deals with eucalyptus as it affects each of the Park Service's three primary management objectives.

Native Vegetation

Based on nearby areas which have been less altered, the native vegetation at Smith Road would probably be coastal scrub/grassland with hardwoods scattered along drainages and on north-facing slopes. A few remnants of native vegetation are present under the eucalyptus. Most plants indigenous to the area are not tolerant of full shade, and those which are tolerant have probably been reduced by toxic chemicals leached from eucalyptus leaves. The only logical way to increase native vegetation would be to eliminate or severely reduce the eucalyptus. This would also involve removing or treating the stumps to prevent sprouting.

Eliminating all eucalytus could lead to other problems, however. Leaning and uprooted trees near the edges of recently created openings in the stand suggest that cutting might contribute to breakage or windthrow. Clearing all trees up to the boundary of the land managed by the National Park Service might lead to failures on adjacent property.

Leaving a windbreak on National Park land would help reduce the probability of windthrow or tree failure on adjacent private property. The placement of a windbreak and the specific method of cutting should be done with reference to the discussion of tree hazard in the following section. Knowing the direction(s) of damaging winds is essential in attempting to estimate the effect that eucalyptus removal may have on adjacent trees. Enclosed is a Forest Pest Management report that summarizes current knowledge of windthrow in relation to wind patterns and methods of tree cutting.

Potential Tree Failure

Tree hazard potential depends upon the likelihood that a tree will fail, and the probability that the tree will strike a target of some value if it fails. Leaning and uprooted eucalyptus, as well as a past history of failures, indicates a fairly high probability that trees will fail in the future. The type of eucalytus present, called blue gum, has a reputation for dropping live branches and uprooting. Managers of Golden Gate Park and East Bay Regional Parks have considerable experience with failures of this species.

Stationary targets such as powerlines and residences occur along Smith Road. The eucalyptus on land managed by the National Park Service are tall enough to span the right-of-way owned by the county if they fell. Eucalyptus within 250 feet of Smith Road, powerlines, and residences can be considered hazardous. Also, there is an access road used for hiking which runs through the eucalyptus grove. Because the targets (hikers) would generally be moving and failures would most likely occur when the ground is saturated or during a storm, which is presumably a period of low use, the hazard in this area is low.

Methods to reduce hazard include moving the target, removing tree parts likely to fail, and removing trees. It is unlikely that Smith Road, the powerline, or residences would be moved to save eucalyptus trees, but the hiking trail could be closed or relocated if tree hazard was a major concern.

Hazard could be reduced by topping trees in a relatively narrow swath near Smith Road and also to a lesser degree along the hiking trail. Topping reduces the size and weight of tree crowns, but by itself, is only a short-term solution. Weak attachment of sprout branches, and decay often associated with topping could cause other problems at a later date.

Thinning stands normally allows residual trees to develop larger root systems and become more windfirm. However, thinning may also allow greater wind penetration into the stand and could cause additional windthrow at Smith Road. The controlling factor is how much of the stand is removed. A combination of thinning and topping might provide the most effective treatment for hazard reduction.

Fire Hazard

Because there is a considerable accumulation of litter, and eucalyptus is remarkably flammable even when green, and the stand is adjacent to residential area, there is a risk of fire. This risk could be reduced in a number of ways. The easiest and least expensive method to reduce the risk of accidental fire would be to close the area to public entry during periods of high fire danger. The risk of fire would also be lower if the accumulation of litter was removed, at least around areas where people tend to park, hike or congregate. A more long term investment would be in a firebreak. Given the tendency for fire in eucalyptus to reach the crowns due to the peeling bark, the height of the trees in question and the strong, prevailing westerly winds, a fire break should be at least as wide as several tree heights.

Management Alternatives

1. **Do Nothing.** The stand is deteriorating, and will continue to do so. Top dieback, branch dieback and uprooting will be common. The trees are so tall for the size of their root systems that uprooting may proceed at a rapid pace if holes develop in the canopy. Fuel loads will build unless the dead material is physically removed. This process normally takes place over many years but could be hastened considerably by drought or by the introduction of serious pests.

2. **Remove all eucalyptus.** Removal of all eucalyptus and treatment of the stumps to prevent sprouting would certainly reduce the fire danger and allow the opportunity for native plants to be established. If the right-of-way was also cleared, the immediate probability of tree failure would be eliminated. Removal of the trees would most likely alter wind patterns from what they have been during the past few decades, and blowdown of trees on adjacent land is possible. Leaving a narrow strip of eucalyptus in its current condition along Smith Road as a windbreak would probably do little to alter the fire hazard and could aggrevate the hazard of tree failure. Positioning a windbreak away from property boundaries and right-of-ways is probably the best compromise.

3. **Thin the eucalyptus.** Thinning the current stand of eucalyptus would reduce the biomass and extend the life of the residual trees (aside from any possible blowdown). This would slow or postpone the breakup of the stand and reduce the amount of fuel, although the fire hazard may still be higher than management is willing to accept. Tree failure potential could be greatly increased depending on the number and distribution of trees removed. Because the stand has grown so densely, the trees have small root systems. The most effective way to thin would be to remove a few trees during each of several entries, allowing 5-10 years between entries for the roots and crowns of the residuals to grow into newly created spaces. Multiple entries which remove small volumes tend to be expensive and may not be compatible with other management constraints.

4. **Modify stands of special concern.** Areas of special concern, such as those adjacent to residences, could be treated in ways that would achieve many management objectives and be acceptable to the public. Treatments could be tailored to meet the individual and varied needs of each site as well as

coordinating with the wishes of the adjacent landowners. Development of written agreements would establish an understanding over the expected results of treatments.

One alternative to create a relatively safe windbreak would be to top and thin the eucalyptus in areas of special concern. This has the advantage that it could be done in conjunction with the removal of other parts of the stand. Depending upon the spacing of residual eucalyptus, native tree species could be interplanted as replacements for the eucalyptus. Obviously, the species of trees planted must be able to survive and grow under an overstory of eucalyptus.

Another approach is to clear small openings in the areas of special concern and plant replacements a number of years in advance of the anticipated removal of the eucalyptus stands. Alternatively, areas of special concern could be completely cleared and planted while leaving the main stand as a windbreak. The main stand could then be removed after the planted trees are large enough to serve as a windbreak. Selection of any of these alternatives carries an obligation for some form of future maintenance. This obligation means that tree characteristics, such as the size of the mature individuals and average lifespan, are critical factors in the selection of replacement species.

OAKWOOD VALLEY

Observations

Oakwood Valley is located south of San Rafael. It is drained by a small creek and has an access road along the east side. This valley has a long history of public use and had several residences in the past. A variety of exotic trees and shrubs have been planted, particularly along the access road. The most abundant exotic tree species is eucalyptus. The most abundant native tree seen was coast live oak, Quercus agrifolia, which tended to occur in small groups. Most of the oak appeared to be rather old, with a few younger trees (less than 50 years old) occurring along the creek. Eucalyptus is encroaching upon and seeding in under the mature oaks. Native shrubs such as beaked hazel and poison oak were common in the understory below the oak.

Discussion

An additional objective for Oakwood Valley is to perpetuate oaks. Although coast live oak regularly produces large amounts of sound seed, regeneration rarely becomes established. The lack of regeneration may be due to either a failure of the acorns to reach mineral soil or heavy feeding by wildlife, such as deer. Regardless of the reason, there are no oak seedlings to replace the groves which are now mature or overmature.

A factor which adds to the problem is that eucalyptus is seeding into the oak groves. Although coast live oak is moderately shade tolerant, it cannot outgrow eucalytus. Coast live oak grows slowly and reaches heights of only 60 to 90 feet at maturity while eucalyptus will reach well over 200 feet. Oaks will decline in number in areas where the two species compete.

Planting will be necessary in order to increase the abundance of live oak. Acorns can be gathered in the fall and either planted immediately or held over the winter. The easiest and most successful way of holding the acorns is in a wire mesh basket sunk in the ground under otherwise natural conditions. Some success has been obtained by planting acorns directly in the field during either the fall or spring and protecting them from seed eaters with plastic or wire mesh cones. These cones do not protect the acorns from underground losses to organisms such as gophers, and they almost always have to be cut away at a later date to prevent them from obstructing seedling growth.

Projects designed to establish a large number of oaks generally utilize transplanted seedlings because of higher survival and lower maintenance, which usually requires less work in the long run. The most successful oak transplanting effort we've seen was done with California black oak by Yosemite National Park. There, 8-foot tall natural saplings were transplanted to campgrounds using the Park's tree spade. The success of oak planting efforts appears to increase in proportion to the size of stock planted.

When small seedlings are planted, protection from above- and below- ground animal feeding is essential, and has been obtained by transplanting seedlings into cylindrical cages made of four foot wide ungalvanized wire mesh. The cages are sunk about 18 inches deep at the time of planting to protect the roots from gophers, and the ungalvanized wire rusts through before it can impair root development. The top of the cage will give some protection from deer and other browsing animals until it deteriorates or the tree outgrows the cage. Coast live oak does not grow rapidly under natural conditions; summer irrigation may increase its growth rate and would certainly increase survival. Control of gophers and competing vegetation will probably be necessary to insure survival for at least the first few years. A survival rate of 50 percent is considered excellent for transplanted oak seedlings. (Valuable information for culturing oaks is included in "Plumb, T. M., 1980. Proceedings of the symposium on the ecology, management, and utilization of California oaks, June 26-28, 1979, Claremont, California. Gen. Tech. Rep. PSW-44, 368p. Pacific Southwest Forest and Range Esp. Sta., USDA For. Serv., Berkeley, California.")

A conservative approach to increasing the amount of oak would be to plant existing small openings. This could be done with a short lead time, and a low investment of time and money. It would also allow the GGNRA personnel to gain experience before making a commitment to a large planting program. After these open areas have been successfully regenerated, and the techniques of live oak culture have been fully worked out, additional areas now occupied by eucalyptus could be cleared and planted.

Because there are probably few people alive who have seen Oakwood Valley when it was not dominated by eucalyptus, there could be opposition to the sudden removal of a significant portion of the woody vegetation. A sudden opening of the stand could also adversely affect some of the plants and animals present which are adapted to a closed canopy ecosystem. Some species would probably increase in response to stand opening, but if they are aggressive colonizers, such as french broom, they may interfere with plans to establish oaks.

The size and orientation of the clearings made by eucalyptus removals may also have an impact on the survival of planted oaks. The air temperature above the

soil tends to increase with the size of the clearing and may reach a temperature lethal to the seedlings. Live oak seedlings may grow significantly better with summer shade, at least for the first few years. Also, depending upon the amount and type of vegetation removed, as well as the time interval between clearing and planting, the newly planted oak seedlings could be the major food source for herbivores in the area.

Management Alternatives

1. **Do nothing.** Eucalyptus will slowly encroach on some, but probably not all, of the coast live oak. Oaks will slowly decline in importance but this will take decades, and oak will not be totally eliminated from the area.

2. **Plant available openings.** Oaks could be planted in current small openings. This would at least maintain the presence of coast live oak, although not necessarily in the precise location of the historic groves. This action would not require a commitment to a large planting program, and would allow experience to be gained in culturing oak.

3. **Tend existing oak groves.** Much of the eucalyptus which is encroaching on the coast live oak is still relatively small. It would be feasible to cut, grub out, or remove this material using hand tools. This would reduce some competition and, if followed up by maintenance every few years, should extend the life of the native stands. If this treatment was combined with Alternative 2, it would increase the presence of oaks without requiring a major program.

4. **Remove eucalyptus and plant oaks.** Complete removal of eucalyptus with subsequent treatment of the stumps to eliminate sprouting would stop the encroachment into existing oak groves. Planting may not, however, establish a continuous cover of oak. Coast live oak forms a very open stand under the best of conditions and usually exists in small groves, or in a mixture with other tree species. There are many uncertainties involved in this type of operation, but the most likely outcome of eucalyptus removal and oak planting would be a reduction in the forest density as it now exists.

KIRBY COVE CAMPGROUND

Observations

Kirby Cove Campground is located just above sea level on a south-facing bench near the north end of the Golden Gate Bridge. The soil in the general area is poorly developed and supports only coastal scrub and grass. The soil appears deeper in the campground and may have been deposited by either seasonal drainages that run through the site or by the military during the construction of an access road and artillery battery.

There is no evidence of any native trees in the immediate vicinity, but the area around the campground has been planted with Monterey pine, Monterey cypress, eucalyptus and a few Douglas-fir. The main portion of the developed campground is occupied by a thinned and pruned stand of Monterey pine and Monterey cypress. Some of the Monterey pine have uprooted in the past, which seems to indicate the soil is shallow and/or becomes saturated at times.

Eucalyptus is concentrated in two areas. The largest group of eucalyptus is in a drainage upslope from the campground. This stand contains no improvements or attractions but is bordered by an access road and parking lot for the use of camping permit holders. Several large, green branches that had broken out during the past winter were present on the ground.

The second stand of eucalyptus is also on a slope outside the main camping area. Pads for tents or sleeping have been excavated between the eucalyptus as an overflow camping area. Most of the pads had an accumulation of eucalyptus limbs, bark and debris. Use of the pads has apparently been light lately because several Monterey pine seedlings have germinated on them.

Discussion

Of the three management objectives for GGNRA, reduction of potential tree failures appeared to be the most critical at Kirby Cove. Most of the hazardous conditions involving eucalyptus could be eliminated through administrative measures or by individual tree treatments. The Monterey pine in the main camping area seem prone to windthrow, but this generally occurs during the winter when the facility is closed to camping.

It is possible that a eucalyptus branch failure could damage a vehicle in the camper's parking lot. One way to reduce this hazard would be to use the parking lot only as a loading zone and require that vehicles be parked elsewhere. Another way of dealing with the situation would be to remove the relatively few branches which are capable of striking the parking lot.

Similar actions could be employed to deal with the overflow camping area. Because camping is allowed by permit only, the simplest solution would be to restrict the number of permits to the number of spaces available in the main campground and cease using the overflow campground. The hazard of limb failure in the overflow area could also be reduced by removing a relatively low number of branches.

The form and spacing of the eucalyptus in the Kirby Cove area indicate that they are relatively sturdy trees with a low risk of uprooting. Removal of some of the eucalyptus would probably not increase the risk of any additional uprooting. Because the Monterey pine has already shown a tendency to uproot and the area is exposed to strong winds, however, removal of large numbers of eucalyptus could actually increase the hazard in the campground rather than decreasing it. This would depend heavily on the direction of damaging winds. Increased exposure to the elements caused by extensive tree removal could also make certain campsites unattractive to many campers until replacement trees are well established.

Management Alternatives

1. **Do nothing.** There are relatively few trees with visible defects. However, many of the Monterey pines are old and large and will continue to uproot and die. Failures will probably occur during the winter when no vehicles or campers are present. There is a low probability of an accident in the near future if current policies and procedures are continued.

2. **Administratively restrict targets.** The degree of hazard posed by tree failure could be lowered by using the existing administrative authority to restrict stationary targets such as parked vehicles and tents from areas perceived to have a high probability of failure, especially during periods of high winds or winter storms when the liklihood of failure is increased. The cost would be minimal, and because access is already restricted, users would probably not perceive a major change in policy.

3. **Remove hazardous trees or tree parts.** Removal of a few limbs or entire trees would reduce the probability of failure to a reasonable point. Identification of hazardous situations should be made during periodic safety inspections.

4. **Remove eucalyptus.** Obviously eucalyptus could not provide any hazard if it was not present at Kirby Cove. Planning to remove any or all eucalyptus from this site requires the same considerations that are discussed for Smith Road. The Park Service needs to determine what effects eucalyptus removal would have on the residual trees in the campground.